Studies on the Food of Nudibranchs

BY

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INTRODUCTION

Although much information is available on the biology of many eastern Pacific nudibranchs, few studies have been directed toward their feeding habits. In contrast to this situation, considerable information is available on the diets and feeding behavior of a large portion of the nudibranchiate fauna of Europe (Forrest, 1953; Graham, 1955; Swennen, 1961; Miller, 1961, 1965; Thompson, 1964) and of the central and west-Pacific (Young, 1966, 1967).

As part of a primary study concerned with the colored pigments of nudibranchs (McBeth, 1970), a preliminary examination was made on the diets of 6 species. The following criteria were used in establishing the food of each species: 1) field observations of the nudibranchs in association with the potential food organisms; 2) laboratory observations of feeding behavior; and 3) occurrence of recognizable food particles in the alimentary tracts and feces of the nudibranchs. All of the species studied were collected from the San Diego area.

RESULTS

Hypselodoris californiensis (Bergh, 1879)

Many dorid nudibranchs studied to date have been found to be rasping sponge-feeders (Graham, 1955; Aboul-Ela, 1959; Swennen, 1961; Miller, 1961, 1965; Thompson, 1964; Young, 1966, 1967). The diet of *Hypselodoris californiensis* was also found to consist of sponges, as demonstrated by field and laboratory observations (see Table 1). Spicules of the particular sponges were often isolated from the feces and alimentary tracts of freshly collected specimens. Individuals of *H. californiensis* were observed and collected from waters ranging from less than one foot to more than 60 feet in depth.

Anisodoris nobilis (MacFarland, 1905)

Anisodoris nobilis was also found to be a rasping sponge-feeder. Its diet appears to consist of a variety of sponges, although it was most often found associated with *Myxilla agennes* in the field. Moreover, the spicules of this sponge occurred most often in the alimentary tracts of freshly collected specimens of *Anisodoris*. The other sponges consumed by this nudibranch were ascertained exclusively

Table 1

Diets of Nudibranchs from San Diego, California

Nudibranch species	Diet
Hypselodoris californiensis	
	Sponges
	Stelletta estrella de Laubenfels, 1930 ([1,2,3])
	Haliclona sp. ([1,2,3])
Anisodoris nobilis	
	Sponges
	Myxilla agennes de Laubenfels, 1930 ([1,2,3])
	Paresperella psila de Laubenfels, 1930 ([3])
	Zygerphe hyaloderma de Laubenfels, 1932 ([3])
	Mycale macginitiei de Laubenfels, 1930 ([3])
	Prianos sp. ([3])
	4 unidentified species ([3])
Hopkinsia rosacea	
	Bryozoan
	Eurystomella bilabiata Hincks, 1884 ([1,2])
Triopha carpenteri	
	Bryozoans
	Scrupocellaria diegensis Robertson, 1905 ([1,2,3])
	Crisia serrulata Osborn, 1953 ([1,2,3])
	Cellaria mandibulata Hincks, 1882 ([1,2,3])
Dendrodoris fulva	
	Sponges
	Clione celata Grant, 1827 ([1,2])
	Ficulina suberea lata Lambe, 1892 ([1,2,3])
	Acarnus erithacus de Laubenfels, 1927 ([1,2,3])
	Suberites sp. ([2])
Flabellinopsis iodinea	
	Hydroid
	Eudendrium ramosum Linnaeus, 1758 ([1,2])

([1]) Nudibranch associated with prey in the field
([2]) Nudibranch observed feeding on prey in the laboratory
([3]) Prey isolated from alimentary tract of nudibranch

from gut analyses (see Table 1). All specimens of *A. nobilis* were observed and collected from waters ranging from 60 to 110 feet in depth.

Hopkinsia rosacea MacFarland, 1905

The results of this study indicate that *Hopkinsia rosacea* feeds exclusively on the pink encrusting bryozoan, *Eurystomella bilabiata*. It was often observed in association with this bryozoan in the field, and consumed it readily in the laboratory. Its feeding behavior closely resembles that described for other suctorial dorid nudibranchs which also consume encrusting bryozoans (Thompson, 1958; Morse, 1967; McBeth, 1968). The nudibranch first rasps a hole in the frontal membrane of the zooid via radular action. The soft parts of the ectoproct are then sucked out as a result of buccal bulb contractions. This feeding response is also similar to that described for those suctorial nudibranchs which consume barnacles (Barnes & Powell, 1954), ascidians (Forrest, 1953) and arborescent bryozoans (Miller, 1965). All specimens of *Hopkinsia rosacea* studied in this work were collected intertidally.

Triopha carpenteri (Stearns, 1873)

The diet of *Triopha carpenteri* was found to consist of 3 species of arborescent bryozoans. Gut analyses of over 100 freshly collected individuals invariably yielded the partly digested fragments of *Scrupocellaria diegensis, Crisia serrulata,* and *Cellaria mandibulata,* listed in order of decreasing abundance. Individuals of *Triopha* were often observed crawling on these closely-associated bryozoans in the field, and consumed them readily in the laboratory. Specimens of *Triopha* were collected from depths of 60 to 100 feet of water.

Many other polycerid nudibranchs have been reported to consume arborescent bryozoans (Graham, 1955; Miller, 1961), and the feeding behavior of *Triopha carpenteri* seems to be quite similar to that described for *Polycera* sp. (Miller, 1965). Branch segments of the bryozoan colony are broken off and ingested by the combination of radular action, grasping jaws, and body contractions. As the engulfed fragments pass through the alimentary tract of the nudibranch, the soft parts are digested away, leaving the intact, identifiable branch segments.

Dendrodoris fulva MacFarland, 1905

The diet of the "porostomes," a group of dorid nudibranchs lacking radulae and jaws, has been difficult to ascertain. Eliot (1908) mentioned that specimens of *Dendrodoris nigra* Stimpson, 1855, from the Suez area, were found "in the cavities of a red sponge which they probably eat." Pruvot-Fol (1954) suggested that the porostomes were probably reduced to ingesting ooze (slime and mud) for nourishment because of their lack of "hard parts."

Two relatively recent reports, however, have established the fact that members of the genus *Dendrodoris* can feed on sponges. Ghiselin (1964) reported that specimens of *Dendrodoris albopunctata* (Cooper, 1863) consumed a variety of sponges as demonstrated by field observations and gut analyses. He observed that during feeding, a tubular structure was everted from the mouth. Young (1966), studying the feeding behavior of *D. nigra* on the sponge *Halichondria dura* Lindgren, 1894, hypothesized that when the buccal bulb is protracted during feeding, the ptyaline gland secretes a substance through the mouth which breaks down the spongin fibers of the prey. The resulting liquid, containing mesenchyme cells and spicules, is then sucked into the mouth by the action of the specialized buccal apparatus.

Specimens of *Dendrodoris fulva* studied in this work were collected from waters 70 to 110 feet in depth. They were often observed with their buccal bulbs everted while humped over sponges, presumably in a feeding response. The nudibranchs were observed on a variety of sponges, both in the field and in the laboratory. In only one instance, however, were sponge spicules actually recovered from the alimentary tract (see Table 1). It is interesting to note in this regard, that both Ghiselin (*op. cit.*) and Young (*op. cit.*) were able to isolate sponge spicules from the intestinal tracts of many specimens, whereas Gohar & Soliman (1967) could find "no identifiable food particles in the alimentary canal" of *D. fumata* (Rüppell & Leuckart, 1828) from the Red Sea.

Flabellinopsis iodinea (Cooper, 1862)

The diet of *Flabellinopsis iodinea* was found to consist entirely of the hydroid *Eudendrium ramosum*. A large number of other aeolid nudibranchs have also been reported to consume hydroids (McMillan, 1942; Pruvot-Fol, 1954; Graham, 1955; Swennen, 1961; Miller, 1961, 1965; Russell, 1964; Thompson, 1964).

Individuals of *Flabellinopsis* were observed crawling on colonies of *Eudendrium* in waters from less than one foot in depth to more than 100 feet. The feeding behavior was observed in the laboratory. When the nudibranch comes in contact with a hydranth, the lips manipulate it into a suitable position for the jaws to grasp. The hydranth is torn from the stalk as a result of 3 or 4 violent contractions of the body. The detached hydranth is then drawn into the mouth via radular action.

DISCUSSION

Some nudibranchs have been found to be very selective in their choice of food organisms (Stehouwer, 1952; Braams & Geelen, 1954; Swennen, 1961; Cook, 1962; Thompson, 1962). Thompson (1964) states that all species of nudibranchs "may have a single preferred food-organism, but in the absence of this it will attack other prey." The sponge-consuming nudibranchs studied in this work do not appear to be species-specific in their choice of food. The results reported herein suggest that *Hypselodoris californiensis*, *Anisodoris nobilis* and *Dendrodoris fulva* all feed on a variety of sponges. Further studies are needed, however, before any degrees of preference can be established.

Hopkinsia rosacea does appear to be species-specific in its choice of food. It was never observed in association with any food organism other than the bryozoan, *Eurystomella bilabiata*. The discovery of relatively large deposits of the unique carotenoid, hopkinsiaxanthin, in the integuments of both *Hopkinsia* and *Eurystomella* (McBeth, 1970) tends to confirm the results of this food study. Future studies on the feeding habits of *Hopkinsia rosacea* specimens collected from other localities along the coast would be of great interest in ascertaining the degree of dependency of the nudibranch's distribution on that of the prey.

Triopha carpenteri and *Flabellinopsis iodinea* also appear to be rather specific in their feeding habits. Comparative pigment analyses of the nudibranchs and their respective prey tend to strengthen this supposition (McBeth, 1970). Before any final conclusion can be drawn, however, more detailed food-preference studies are needed, including comparisons of distributional patterns.

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